Meeting Notes
California State Lands Commission
Performance Standards Technical Advisory Panel Meeting #2
Wednesday, April 27th, 2005

Meeting Attendance

Marian Ashe - CA Department of Fish & Game	Steve Moore – SF Bay Water Board
John Berge - Pacific Merchant Shipping (Conference Line)	Sarah Newkirk - Ocean Conservancy (Conference Line)
Andrew Cohen - SF Estuary Institute	Greg Ruiz – SERC (Conference Line)
Brad Chapman – Chevron Texaco Shipping	Lisa Swanson - Matson Navigation
Maurya Falkner – CSLC	Lynn Takata - CSLC
Suzanne Gilmore – CSLC	Drew Talley – SF Bay Estuarine Research Reserve
Jeff Herod – US Fish & Wildlife Service	Kim Ward - SWRCB (Water Quality Division)
Giselle Johnston – CSLC	Nick Welschmeyer - Moss Landing Marine Laboratories
Jackie MacKay – CSLC	

Handouts
- Summary spreadsheet of other BW programs outside CA
- Public Resources Code Section 71204.9

Welcome & Introductions

Greg Ruiz Presentation via Conference Line
Greg provided background information on the delivery of organisms in ballast and the efficacy of ballast water exchange. Results were shared from applied studies on biotic tracers (zooplankton, phytoplankton, viruses and bacteria) and water tracers. Studies included results from bulk carriers, tankers and container vessels with routes on both coasts. Several main points are outlined as follows:

Abundance for organisms in untreated ballast arriving from overseas is generally:
- High for zooplankton and low for phytoplankton.
- Low for bacteria and viruses.
- Densities of zooplankton on coastally traveling vessels are very high for those 80 microns and larger (higher than foreign arriving vessels) most likely due to short transit time.

Efficacy for 100% empty refill (ER) and 300% flow through (FT) exchange:
- Rhodamine dye to measure water exchange
    - 100% ER eliminated nearly everything (99%)
    - 100% FT eliminated about 70%

    - At 300% FT, nearly all water is exchanged (99+%)
- Efficacy of exchange for organisms:
    - Efficacy is about 88 – 99% efficient across vessel types (tankers, containers, bulkers).
    - Containers exhibit the lowest efficiency – may be due to tank geometry & size.
    - According to USCG reports, most vessels are doing Empty Refill exchange. Although by total volume of water, fifty percent is exchanged by the Flow-Through method and fifty percent is exchanged by the Empty Refill method.
- Exchange efficacy for biota:
    - Desirable biotic tracers were abundant, coastally located, and easily identified – zooplankton were used (copepods, barnacles, mollusks, annelids & others).
    - Exchange experiments were performed onboard 6 tankers
        - ER (100%) removes high numbers of organisms, as well as rhodamine dye.
        - Variance was high, ranging between 80 – 99%.
        - There was a low % of organisms left, but this may still translate to high numbers of organisms if initial concentrations were very high.

Main points:

- Exchange has a significant effect.
- Exchange can be as good as 99% removal of organisms but in larger tanks with more water, exchange efficacy tends to decrease.
- Ballast water associated with coastwise traffic contributes higher numbers of viable organisms than ballast water associated with foreign traffic.
- Performance Standards should be much more effective than mid-ocean exchange.

The best efficacy results were found to be with the empty refill technique, although the data shows a broad scatter, which tends to depend on sample size. Dye has shown a high rate of exchange but the same has not been true for biological organisms.

In three hundred ships sampled on both coasts, most were found to have less than three thousand organisms per cubic meter of ballast water. Accordingly, it appears that the IMO standards (10 viable organisms >50 um in length per cubic meter, 10 viable organisms >10 um and <50 um per milliliter, 1 colony forming unit (cfu) Toxigenic Vibrio cholerae (01 and 0139) per milliliter, <250 cfu per 100 milliliters E. coli, and <100 cfu per 100 milliliters Intestinal enterococci) would require a significantly larger reduction of zooplankton communities but less of a reduction of phytoplankton. The challenge of identifying appropriate standards is to find the relationship between density and the associated risk of colonization. The shape of a dose response relationship is unknown (i.e. what is the relationship to number of organisms in a tank vs. actual NIS establishment). There is most likely some threshold, but this threshold is highly unknown and may be impossible to identify. It is likely that we need to proceed without a firm understanding of what the dose response relationship is. The results presented on ballast exchange experiments will be submitted for publication in late-summer 2005.

Nick Welschmeyer Presentation
Nick summarized his findings from evaluation voyages on two vessels, which were fit with the Optimar Ballast Water Treatment System that uses hydro-cyclonic separation and UV treatment. The Sea Princess is a passenger vessel that typically transits from Los Angeles, California to Mexico, and the RJ Pfeiffer is a container vessel with a transit route from Honolulu to Oakland, California. The system evaluation included a count of the viable organisms after treatment including estimates of live/dead counts. Tests included measurements for virus like particles, bacteria, cultivable bacteria, phytoplankton, zooplankton (including grow out experiments), Pulse Amplitude Modulated Fluorescence (which measures photosynthetic production), ATP, as well as carbon and nitrogen analysis. The active dynamic flourometer appears to be a good approach to measure photosynthetic density especially because it is independent of density.

Main Points:
- The Optimar ballast water treatment system does not produce instant results; it requires time to be effective.
- Variability was high between tanks, illustrating that ballast tanks are not ideal test tubes.
- Plumbing and light bulbs were difficult engineering problems. Future treatment system installation projects may benefit from the issues discovered and resolved during the West Coast Demonstration project.
- Chlorophyll may be a good natural tracer for testing ballast water efficacy. There are representative estimates of concentrations for estuarine systems versus open ocean systems. Based on typical surface concentrations, an equation for exchange efficiency percentage can be calculated.
- RJ Pfeiffer results show 99% open ocean exchange efficiency.

Andy Cohen Presentation
Andy's points to consider while developing panel recommendations:
- Ballast water exchange isn't good enough.
- With current levels of knowledge, we are unable to predict with any reliability which species will invade or be harmful and which ones will not; so to manage the problem we must reduce the overall number of live exotic organisms being discharged, rather than target particular species.
- Since we have no idea of the shape of the 'dose response curve', we should start by assuming that there is a 1:1 relationship (meaning that an x% reduction in the rate of discharge will result in an x% reduction in the rate of invasion) until research informs us otherwise.
- Ballast water is introducing an estimated 1-10 exotic species per year in California. (If anything, this estimate may be a bit on the low side, since over the last few decades (a) an average of one new species has become established in the San Francisco Estuary every 14 weeks (= 3.7/year) (Cohen & Carlton 1998), (b) ballast water has been responsible for 50-90% of new invasions to this system, and (c) these estimates do not include cryptogenic species, species in many poorly studied

taxonomic groups, or species introduced to areas outside of the San Francisco Estuary).

- Extrapolating from the distribution data for well-studied taxonomic groups, for any major ocean coast (such as the west coast of North America) there appear to be less than 100 species that invaded naturally across the ocean over the past million years (i.e. <1 species/10,000 years).
- So, to reduce the current invasion rate down to something on the order of magnitude of the natural rate, and assuming a linear 1:1 dose response curve, we would need to reduce the rate of discharge of live exotic organisms by 10^4 to 10^5 (reduction of 99.99 % to 99.999%).
- With an estimate of the mean density of living organisms in untreated and un-exchanged ballast water discharges at the end of a transoceanic voyage (which we can get from Greg Ruiz's data and other studies), we can calculate a post-treatment density standard that would meet this goal.

Andy then discussed the feasibility of removing organisms in ballast tanks. The annual quantities of ballast water discharges were outlined as well as the annual treatment capacities of wastewater and drinking water facilities. Main points from this discussion:

- 99.99%-99.999% reduction targets are technically feasible. In fact, we have the technical capability to remove or kill organisms from a tank of water to whatever level we desire.
- For example, every year treatment plants in the Bay Area disinfect (that is, remove or kill the organisms in) 100-1,000 times as much water and wastewater as the volume of ballast water discharged into the Bay and Delta.
- The real question is economic feasibility. To assess this, we need to evaluate the costs of treatment technologies, and the shipping industry's ability to pay, and compare them.

It was suggested that the Committee should identify the economic costs associated with treatment procedures and then compare these to the shipping industry's ability to pay. This concept assumes that the economic burden for ballast water treatment will mostly be on the industry (to the extent that government is expected to subsidize treatment costs, this should be included in the assessment of economic feasibility). Items to examine to assess the industry's ability to pay would be industry profits, industry revenues, and the value of cargo carried. Ultimately, the objective would be to evaluate if the industry has an ability to pay for treatment that reduces the discharge of ballast organisms down to a level where the anthropogenic invasion rate is around the order of magnitude of the natural invasion rate; and if not, to estimate what standard of treatment the industry could pay for.

References:

Cohen, A. N. and J. T. Carlton. 1998. Accelerating invasion rate in a highly invaded estuary. *Science* 279: 555-558.

Steve Moore & Kim Ward
The Regulatory Framework for Water Quality Control in CA: Possible Applications for Controlling Ballast Water Discharges
Steve and Kim provided an overview of the existing regulatory framework for water quality management in California, which may be adaptable to manage ballast water discharge.

The Federal Clean Water Act is implemented using a National Pollutant Discharge Elimination System (NPDES), which controls surface water by regulating point source discharges. Protection of water quality and beneficial uses in California are implemented with 'water discharge requirements' and NPDES permits issued by nine Regional Boards and the Water Quality Control Board. Several beneficial uses were outlined: Municipal, domestic, agriculture supply, recreation, fish consumption, and aquatic life protection. Water quality objectives are developed with numeric concentrations for water bodies (e.g. copper: 3.1 ug/L).

Commercial industries are generally regulated by NPDES permits, triggered by the addition of pollutants into the environment. A recent court decision determined that commercial vessels do produce point source pollutants that are subject to the NPDES process. The USEPA exemption for ballast water was in place before biological organisms were considered pollutants. Invasive species are now considered biological materials.

Several issues need consideration when determining how best to regulate discharge of ballast water:

- It is hard to determine compliance in water that has been diluted with several sources and quantities of water such as ballast.
- It will be difficult to measure and/or monitor ballast water discharge standards based on source water (input) versus discharge (output).
- Studies need to be conducted through bench scale trials to identify the most promising techniques, which can be applied using a permit process.
- NPDES permits could possibly be issued to responsible parties such as ports, shipping companies or shipping agents.
- Several strategies were discussed to implement the permitting process using model examples for General permits and dredge and fill permits under CWA section 404.

Under the Clean Water Act, it is feasible to name landside entities as responsible parties for vessel compliance through general permits. Agencies could issue these permits to companies on any level such as individual vessels, owners of fleets, or the agents. In Steve's opinion, State and federal agencies handle complex issues very similar in other industries, and they are capable of regulating the shipping industry.

Summary of Group Discussion Following Presentations
Main points from the group discussion:

- Regional consistency of ballast water standards is extremely important.

- A standardized methodology by which all treatment systems would be evaluated is necessary to verify if the standards are reducing the rate of invasions.
- It will take five, maybe ten years to accurately measure if the rate of introductions is less after the standards have been implemented.
- The IMO has established a phase-in period for the international standards that allows time for monitoring techniques to be developed.

There will be a need for patience during long-term studies to make evaluate if standards are effective over time. However, long-term monitoring has been historically under funded in California when compared to other states. Agencies enforcing the Clean Water Act have been substantially under funded even for mandatory programs in place.

There is definite need for ongoing biological monitoring and assessment. Funding sources for these types of programs will be a challenge in California. Some discussion took place about the adequacy of current baseline studies of California coastal regions. There were several taxonomic and classification issues, again there is need for funds to re-visit specific areas of the baseline data.

Several ideas for the next meeting were discussed:

- Present information about possible treatment systems and the efficacy of those systems. Currently, there is no treatment system approved by the State Lands Commission.
- Decide on areas of agreement with respect to how standards should be implemented.
- Decide how long term monitoring and enforcement should be implemented.
- Begin developing numbers for standards.
- We should be as specific as possible, we should document areas we agree unanimously as well as document areas of disagreement.
- Andy stressed the need for an economic analysis before recommendations are developed and the identification of the industry's ability to pay, considering cargo and gross receipts as well as economic information about treatment facilities.

Current Action Items:

- SLC staff to develop a list of treatment technologies and corresponding efficacies
- Research economic context for the establishment of performance standards
    - Gather independent data from/for the shipping industry
    - Research the industry's ability to pay for treatment technologies
    - Gather cost estimates of treatment systems
    - Compare data
- Industry representatives to meet and formulate recommendations/ideas
    - Provide economic information for above item
- Ideas for future projects
    - Bench-scale studies are needed to test regulatory techniques

Adjourn: 1:00 pm